

Extreme-Precision MEMS Segmented Deformable Mirror, Phase II

Completed Technology Project (2007 - 2009)



Project Introduction

In Phase I research, Iris AO developed enhanced electromechanical models and calibration techniques for MEMS-based segmented deformable mirrors (DMs) applicable to a variety of high contrast astrophysical imagers. High-precision DMs with 1,000-1,000,000 actuators are critical for high-contrast systems. Non-MEMS DMs meet some NASA requirements, but require high actuation voltages, have low actuator densities, and do not scale readily beyond a few thousand actuators. MEMS DMs offer natural scalability, but do not yet meet the stringent precision and stability requirements for space telescopes. Prior to this Phase I work, very few researchers have focused on extremely precise characterization of MEMS DMs. Technical advances achieved in this Phase I improved open-loop positioning accuracy from nearly 100 nm rms to an impressive 8 nm rms. Stability measurements showed performance as good as 0.21-1.17 nm rms in an uncontrolled open-access laboratory over a 15-minute span. Including high-frequency noise sources not captured by Phase I optical measurement techniques but known to be present on the DM segments, this rises to 5.6 nm rms. Noise source analysis conducted in Phase I shows that stability to <0.2 nm rms is feasible. Phase II will implement the improvements necessary to attain <0.3 nm rms stability and resolution. These improvements include: 1) reducing known noise and drift sources identified in Phase I and tracking remaining measured but unknown noise sources; 2) increasing resolution to 0.14 nm rms through enhancements in drive electronics initiated in Phase I and optimizing the DM design to utilize the full dynamic range of the electronics; 3) improving optical quality of the Iris AO DM segments to 1-3 nm rms; 4) testing resolution and stability of the prototypes; 5) expanding reliability testing that started in Phase I and 6) investigate the effects of operating in vacuum.



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Organizational
Responsibility**Responsible Mission
Directorate:**

Space Technology Mission
Directorate (STMD)

Lead Center / Facility:

Goddard Space Flight Center
(GSFC)

Responsible Program:

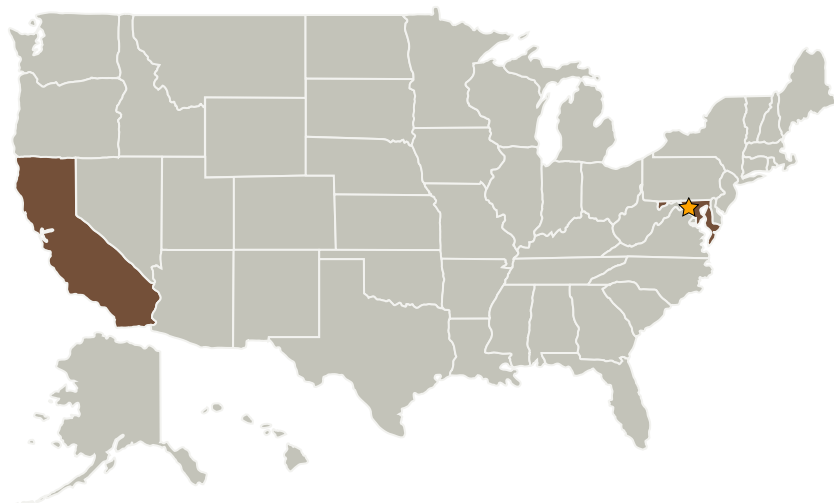
Small Business Innovation
Research/Small Business Tech
Transfer

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Primary U.S. Work Locations and Key Partners



Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Technology Areas

Primary:

- TX08 Sensors and Instruments
 - └ TX08.2 Observatories
 - └ TX08.2.1 Mirror Systems

Organizations Performing Work	Role	Type	Location
★Goddard Space Flight Center(GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland
Iris AO, Inc.	Supporting Organization	Industry	Berkeley, California

Primary U.S. Work Locations

California	Maryland
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